

Visualising human-animal-technology relations: fieldnotes, still photography and digital video on the robotic dairy farm

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Abstract

This paper explores the potential for developing less anthropocentric approaches to researching human-nonhuman relations through visual ethnography, critically examining the potential for conceptualising nonhuman animals as participants. Arguing that method in “more-than-human geography” and animal studies has developed at a slower pace than theory, it proposes visual approaches as a means through which to foreground the behaviour and actions of nonhuman animals in social research. This challenges underlying anthropocentric assumptions of visual ethnography, questioning the meaning of “participation” in visual research. The paper presents a comparison of approaches used in studying practices of robotic milking on dairy farms in the UK. Specifically, it compares the qualities of field notes, still photography and digital video in focusing on particular sites, moments and movements of robotic milking. While visual approaches are not a panacea for more-than-human research, we suggest that they do offer a means through which nonhumans might “speak for themselves” in social research. Rather than presenting definitive accounts, the inclusion of video in such work not only illustrates arguments but also leaves the actions of nonhumans open to further interpretation; the centrality of the researcher is destabilised.

Keywords

Visual methods, Photography, Video ethnography, More-than-human geographies, Robotic milking

Introduction

This paper examines the potential of still photography and digital video for producing less anthropocentric studies of human-nonhuman relationships. Our interest is prompted by the developing literature on “more-than-human geographies” (Whatmore, 2006). This has drawn on the relational ontologies of, for instance, actor-network theory (Latour, 2005) and assemblage theory (DeLanda, 2006) to argue that social relationships are not confined to humans but also involve nonhuman actants such as animals, plants and technologies, and that the practices and interactions of nonhumans are co-constitutive of place. Much of this research has focused on “animal spaces” (Philo & Wilbert, 2000) – the spaces allotted to nonhuman animals by humans, and associated representations. The nonhuman activity that co-produces “beastly places” (*ibid*) has often remained in the background of analysis. We argue here that this is partly a result of the relative methodological conservatism of more-than-human research, which often retains a “residual humanism” (Lulka, 2009). This paper takes a critical perspective on the potential of visual approaches for engaging with “beastly places” through studying relationships that develop around new milking technologies on dairy farms.

Specifically, we draw on fieldwork that looked at how installing robotic milking machines on UK dairy farms affects relationships and routines of dairy farming (see also Butler, Holloway, & Bear, 2012; Holloway, 2007; Holloway, Bear, & Wilkinson, 2014a; Holloway, Bear, & Wilkinson, 2014b). In conventional dairy systems, cows are fetched twice-daily into a collecting yard, before being brought in small groups into a milking parlour, where farm workers attach a unit by hand to their udder. In contrast, a robotic milking machine consists of a “box” into which the cow walks when she wants to be milked. Upon entering, the robot reads an electronic collar around the cow’s neck and determines if it is time for her to be milked. If it is, the robot gives her a measured ration of feed and prepares her for milking. Using cameras or lasers, the robot senses the position of the cow’s udder and may over time “learn” the shape of the udder on each cow for faster attachment of the units.

During milking, the robot continually adjusts as weights under the cows' feet indicate when she has moved in the box. After milking, the robot applies a pre-set amount of disinfectant spray and releases the cow, using mild electric shocks or compressed air to encourage the cow's exit if she stands for too long. Robotic milking thus changes the milking experience for humans and cows, separating farm workers from the milking process and replacing their judgements and actions with automated processes. Nevertheless, farmers still need to retain control of the animals by understanding their health and welfare needs, yield and behaviour. The robot thus supplies farmers with a range of information gathered during milking, including milk temperature and conductivity (an indicator of health problems), the cow's weight, and data from pedometers indicating how far the cow has walked (which can suggest changes in fertility and mobility). The cows in turn must learn to attend the robot to be milked; those that do not, or who have unusually shaped udders that make it difficult for the robot to attach the unit, are often removed from the herd entirely. In an "ideal" robotic milking system the herd of cows will develop a level of self-sufficiency that means they need rarely be seen or handled by the farmer. Indeed, the farmer may choose to spend the day away from the farm entirely, doing work or spending leisure time elsewhere.

Studying the more-than-human geographies of robotic milking – understanding how places are co-constituted by heterogeneous actants – raises specific methodological problems. As a central purpose of the robots is to reduce the need for human presence and contact with cows, research methods that rely on verbal and textual communication were far from adequate. Visual methods provide one potential route to decentre the human in such research, reducing reliance on spoken human interpretations of animal and technological actions, and giving the animals and technologies greater "voice." This paper has two broad aims, therefore: a) to critically examine the potential for conceptualising nonhuman animals as participants in visual ethnography; and b) to explore the potential of visual ethnography for the development of less anthropocentric approaches to researching human-nonhuman relations.

The next section gives an overview of the theoretical impetus for this paper, summarising the development of more-than-human geography and outlining related methodological issues. Subsequently, we compare different approaches to conducting and recording ethnographies of robotic milking – using field notes, still photography and digital video – before discussing the implications for future more-than-human methodologies, and for the involvement of nonhumans in the research process.

Animals beyond words

While the ways humans represent animals remain central to research in animal studies, work in this area has increasingly heeded Philo's (1998, p. 54) call for texts to give "a sense of animals as animals." Animals have thus increasingly been analysed as active co-constituents of social relations. In spite of these significant conceptual developments, methodological developments have been slower (J Lorimer, 2010). Many studies have continued to favour text- or voice-based methodologies (e.g., Holloway, 2001; Holloway, Morris, Gilna, & Gibbs, 2009; Wilkie, 2010; Riley, 2011; Convery, Mort, Baxter, & Bailey, 2008) and while these have deepened understandings of human-animal relations, their reliance on interviews and other such textual media inherently "favor[s] the articulate" (Prosser, 2013, p. 195).

Other research has been more open to a wider conceptualisation of "articulate," engaging more directly with the embodied actions of nonhumans. This has often involved participant observation, focusing on nonhuman animals in their interactions with humans (such as pets in family life [Power, 2008; Fox, 2006]). Using such an approach has led some researchers to take a critical approach to their relationship to nonhuman participants. Sellick (2006), for instance, employed ethnographic techniques to study the "fleshy bodies" of cows and consider her own personal response (as a vegetarian from a non-farming background) to the relationship she developed with a herd of cattle.

Risan (2005) similarly conducted participant observation on a dairy farm, but considered the role of subjective interpretation, looking not only at how he interpreted the actions of the cows but also at how they interpreted their relation to him. H Lorimer (2010) took these themes forward in relation to his encounters with seals, highlighting the difficulties of defining, describing and making sense of the co-constitutive relationships at play. All of these approaches retain – often very deliberately and explicitly – more than an air of humanism. While focusing on embodied relations, keepers, owners, observers and even the researchers are often left to speak for the animals. Others studies have attempted to further foreground the animals themselves. Notably, Hinchliffe, Kearnes, Degen and Whatmore (2005) very literally included nonhumans in their study of urban green space, “reading” water vole “writing” (their spraints and footprints), giving a greater sense of their presence and actions. Taken together, the work outlined here represents researchers’ increasing willingness to attempt to become attuned to different, more-than-human, forms of articulation. In this paper, however, we engage more specifically with a small body of work that promotes visual methods as a means to destabilise inherent inequalities in more-than-human research.

While participant observation is inherently reliant on the visual – in a way that interviewing is not – some researchers have employed tools such as photography and video in developing a visual record and dissemination of their research. In particular, video has been employed to capture and analyse moments of human-animal encounter in the becoming (Brown & Dilley, 2012, p. 39; see also Brown & Banks, 2014), rather than relying solely on post-event human articulation. Laurier, Maze and Lundin (2006) and Brown and Dilley (2012), for instance, all used video to analyse interactions between humans and their dog companions. Laurier et al. (2006, p. 4) argued that studies of these relationships based on interviews “are ethnographically inadequate because they are premised on the notion that what people do with dogs can be fully established from what people say about what they do.” While Laurier et al. made their own recordings, Brown and Dilley adopted a mobile video ethnography, where the dogwalkers (though not the dogs) wore headcams. Through these approaches, these two studies exemplify the benefits J Lorimer (2010, pp. 243-244) identifies of

using moving images in more-than-human research: a) the “images help witness bodily practice”; b) the “images illustrate the uncertain processes through which human and nonhuman protagonists “learn to be affected” by the unfolding of events”; and c) the “images help deepen analyses of the power relations that run through the...multi-species, multicultural triangles [Western visitors, elephants and mahouts in his case] on display.”

In such ways, the use of video is promoted as an innovative way of: decentring the human in more-than-human studies; exploring relations-in-becoming; and moving beyond an over-reliance on textual representations. However, Brown and Dilley (2012, p. 39) continue to emphasise dogwalkers’ “memories and feelings of dogwalking experiences,” albeit elicited through discussion of the videos. They also comment on the difficulty of interpreting headcam footage outside of further discussion with the participants (ibid). While the dogs are foregrounded to a greater extent than in more traditional interview-based studies, their owners still generally have the final word.

The focus of our research was different to the studies outlined here, which, with the exception of Hinchliffe et al., focused on direct interactions between humans and animals. In contrast, we wanted to explore the relationships and practices that develop around milking robots. Because farmers spend relatively little time with cows in robotic systems, we adopted visual approaches to foreground nonhuman actions and practices, while giving a greater sense of relationships and practices away from direct human contact.

While visual approaches are appealing in allowing animals to become more viscerally and visibly present in research, the assumptions that underlie visual ethnography are often inherently anthropocentric. First, tactics commonly used with human participants in visual methods (such as follow-up video elicitation interviews) are simply not possible with non-humans. Moreover, while a central tenet of ethnographic work is to “give relatively poor and powerless people ... a long-denied chance to have a voice in the ways in which they are portrayed” (Crang & Cook, 2007, p. 58), nonhuman actants will have little direct say in (and even less understanding of) their portrayal.

Human participants can “use their own understandings of how video can communicate to inform how they both actually experience and perform... their experiences for the video” (Pink, 2007, p. 250). In Pink’s (2013, p. 79) discussion of ethnographic photography, she implies that participants might have choice in how their subjectivities are displayed; the researcher, for instance, might show them the photos they have taken, allowing participants to comment on their appropriateness. As well as having a say in the representations produced, participants can actively direct the research agenda, guiding “you to what they think is important” (Garrett, 2011, p. 531). The co-productive nature of visual ethnography with nonhumans differs intrinsically in these areas: while nonhuman animals might act in specific ways during research, it is highly improbable that this will be through a reflexive understanding of how images might be used, how they are being represented or, indeed, how their actions relate to a research agenda. It would be possible for nonhumans to be directly involved in the production of visual footage (see Haraway, 2008), but their participation would be functional, rather than reflexive. In these ways, any notion of nonhumans being reconceptualised as research *participants* becomes intrinsically problematic.

In the next section, we examine our own use of visual approaches, comparing the utility of field notes, still photography and digital video in producing less anthropocentric research data. We return more specifically to the problems raised in this section in the conclusion.

Employing visual approaches in more-than-human research

While our focus here is on visual approaches, our project drew on a review of literature produced by robot manufacturers, 54 interviews with, among others, farmers, robot manufacturers and animal welfare organisations, and three week-long periods of observational research (on a commercial robotic farm, an agricultural college farm with both robotic and conventional systems, and a farm that was converting to robots), with subsequent follow-up observational fieldwork. The

observational research involved spending time in cow sheds, watching the milking process, speaking to farm workers, observing the flows, practices and dynamics of herds and individual cows, and using the computer systems to view data about the animals. It is in this observational work that we utilised visual methods.

Our observations around the farms were partly structured by a “shooting script” (Suchar, 2004), where we identified possible moments of interaction relevant to our project aims, rather than attempting to “document” all of the farm activities. We focused on particular: sites (e.g., the robot and its immediate surroundings, the office/computer room and the barn); moments (including milking, feeding and data analysis); and routes and movements (tracing the movement of an individual animal over the course of a period of time, recording the flow of a group of cows). This enabled us to make “specified generalizations” (Becker, 2002) about the nature of human-animal-technology relationships, illustrating our arguments about the subjectification of cows, for example, by showing instances of their “choosing” whether or not to be milked.

Becker (2002) uses the term “specified generalizations” to refer to the ways in which photographs can offer examples that give deeper meaning to a more general argument. Photographs, argues Rose (2012, p. 323), make arguments believable: they “do not simply illustrate the researcher’s arguments...they work more actively to convince us that those arguments are correct.” The data gathered using visual methods goes much further than providing mere illustrative material, however, allowing the capture and reproduction of non-verbal information, including from nonhumans.

In this section, we make a direct comparison of photography, video and field notes as tools through which to research more-than-human relationships, illustrating opportunities and problems associated with them. We focus on a morning of observational research carried out at an agricultural college farm, where each approach was used to examine the more-than-human relationships in different ways: by following an individual animal, by focusing on the specific site of the robotic

milking machine, and by observing cows outside the barn, in a non-robotic grazing system. The tactic of following an individual animal was adopted to get a sense of: how cows navigated (and co-produced) barn space; what interactions they had; and (most broadly) how they spent their time. Through this, we also aimed to engage with nonhuman difference, exploring relationships between individual cows and their herd, rather than simply treating the animals as “cows.” Having followed three individual cows, using each of the approaches, the second stage focused on a single site within the barn. As the research is about relationships between farmers, cows and robotic milking machines, we focused on the robot itself in order to get a sense of the interactions that took place around it but also to give the robot a more active role in the research. The final location was an open field, where cows grazed on grass and were herded up twice a day for milking in a conventional parlour. This raised quite different issues, especially as the cows were far more spatially dispersed.

While we acknowledge that it is more conventional to combine these approaches, for the purposes of this paper we have separated them – an issue we return to in the conclusions. The intention is not to conclude that any one is necessarily superior to another, but rather to explore the specific strengths and weaknesses of each. Also, we do not offer a detailed analysis of the data here; rather, the focus is on examining approaches to producing data on more-than-human relationships.

Fieldnotes

We begin with our fieldnotes, to make explicit their strengths and limitations in researching more-than-human relationships before going on to highlight the different qualities of still photography and video. Although fieldnotes most often rely on the written word, their use here was designed to draw on their ability to capture articulations in-the-becoming, and to move beyond representations of nonhumans that are generated in contexts such as interviews. These, in other words, are one means of recording visual (alongside aural and tactile) observations.

The fieldnotes made by the researcher while following an individual cow in a barn highlight cow 200's sedentary nature: for much of the time, the cow simply stood, chewed and sat. The researcher's search for happening is telling from the notes:

I did also choose this [cow] in the hope that the fact that she was already standing might make her more likely to move somewhere – i.e. I was hopeful of seeing *something happen*, rather than just watching a cow sit for 30 minutes.

The notes describe cow actions, movements and interactions in some detail. For instance:

She lowered her head to the ground, flicked her tail, briefly lifted her front right leg and then stood still. 327 came and stood 6ft behind her. 200 moved forward a little, then stood for a minute, then gradually moved forward, sniffing around the hind quarters of 183, who was leaning out of the barn to feed.

These notes appear almost ethological; in attempting to document the microgeographies of the barn, the focus shifts to recording “empirical” descriptions (Lehner, 1996, p. 81) of cows' actions. However, as such observations became repetitious, the focus often moved to the barn environment – the context for this individual – describing constant background noise from passing tractors and suchlike, as well as the noise of cows putting their heads through the feeding fence.

While on this particular day we were the only humans in the barn, other people were present on other field visits. On these days, the notes were very similar, though included observation not only of cows interacting with each other and the robot but also with the farm workers. For instance:

Steve returns from the tractor with a draining rod (plastic stick) and fetches a cow to the robot, using the stick both to hit the cow and to wave it to prevent it turning the wrong way. It seems to be quite difficult for one person to do this – he needs to be on both sides of the cow at the same time.

The key difference that human presence makes is the ability of the researcher to ask questions and receive spoken answers. Steve therefore talks to the researcher about how that day's experience relates to his usual work, along with some reflection on why there might be a difference:

This afternoon, he has 9 cows to bring to the robot rather than the usual 6-7; he thinks this is because they have been put off milking by the foot trimming taking place. He also said that the cows tend to have their place in a queue – so if they miss a milking because of foot trimming etc they may have missed their “chance” to be milked for a while, because other cows behind them in the normal queue will be being milked.

Overall, the fieldnotes offer something approaching an ethnographic account of a cow's time in the barn. While guided by the cow's movements and actions, the notes often remain somewhat distant and separated from the cow, maintaining an air of objectivity. The act of note-taking in the field, however, also permits some level of reflexivity. For instance, at one point, the researcher lost sight of the cow and struggled to find her again:

I had tried walking around to the central area so as to be able to look down on her but I couldn't identify her when I got round there. Other than her number, I hadn't noticed any especially distinguishing features.

Fieldnotes, in other words, do not merely operate as a “factual” record of cow-robot interactions but also can draw attention to the research process (and its inadequacies), as well as to ideas about the subjectification and individualisation of animals – in this particular instance, the difficulty of distinguishing between individuals.

The second set of fieldnotes, focused on interactions around the robot, is also ethnographic in form, combining specific observations with reflexive commentary. A simple story emerges of the milking process, as told from behind the robot:

The cow enters the robot after some hesitation...the gate closes with a hiss. The cow is stamping a little – impatient? It takes the robot several minutes...to attach the teat cups, including removing one of the successfully attached cups and starting again. Eventually after 2-3 minutes all four teat cups are attached. The loud staccato noises of the arm moving around end and are replaced by the softer rhythm of the pulsator. One of the quarters comes off again very quickly and the cow starts to nudge at another with its hoof. Shortly after two more come off. The arm makes several readjustments whirring back and forward before the milking ends after just a couple of minutes. The robot then engages in its own activity after the cow has left- the milk drains away, the teat cups are cleaned and the arm returns to its “resting” position.

Here, the robot is foregrounded, along with its interactions with a cow. Again, this is less a picture of robot “use” than an example of learning, experimentation and acclimatisation, whereby the robot must continually adjust to the cow’s uncertain responses. Beyond this observation, a commentary emerges through which analysis begins. Walking around the robot, the researcher notes:

Attempt to make back of robot like a “dairy” – hygiene rules, chemicals, hoses... It is a reminder that no matter how novel the robots are they exist within a very defined and controlled system of dairy production where the “messiness” of cows must be eliminated as far as possible... The two sides are designed very differently – one to be monitored and manipulated by the human, one to be “mistreated”? (i.e. kicked) by the cow.

Again, therefore, ethnographic notes provide not only a record of observations but also an initial stage of analysis; as Plath (1990, p. 378) put it, fieldnotes are “as much an instrument of discovery as of reference.”

The third focus – the open (non-robotic system) field – raised many of the same issues, but the scale of the space introduced a significant difference. While the observation process was ostensibly the same as around the robot, the researcher commented:

From the start it is difficult to know what/where to look and what to note. The shift from trying to overview the whole field to focusing on a small group made a big difference, but at the cost of losing other things such as the wider “patterns” of movement, “herd behaviour” and interaction in the wider herd of cows... The nature of the site also makes it more difficult to do other than watch from a distance and elevated position – walking into the middle of the field might have “disturbed” the cows more than such close observation in the housed herd.

Again, then, in this brief experimental period of observation, the researcher records his concerns around his potential impact on the animals. If another human had been present, such as a farmer, this presence would not seem so problematic (one farmer told us that milk yield reduces when humans are present in the barn, whether or not the cows are used to the individuals concerned). However, the intention here was to record social interaction in human absence; while others, such as Risan (2005) have embraced the presence of the researcher, here we felt it went against the aims of our research.

During the following of the cow and in the open field, the researchers drew illustrative diagrams. The former (Figure 1) was designed to show both the route taken by the cow, as well as the proximity to the researcher (and the robot) during a period of observation, while the latter (Figure 2) attempted to show the dispersal of cows across the field, the activities they were engaged in and their proximity to key sites. While both are quite unsophisticated in form, they serve as a reminder of the more-than-written possibilities of field notes, which themselves can offer visual interpretations of (more-than-visual) observations.

Figure 1 here

Figure 2 here

Reliance on fieldnotes, then, does not preclude a recentering of research on animals and technology, and away from the human. Fieldnotes also promote reflection and interpretation of what is being observed, and of the researcher's place in this, driving the research process and helping to make explicit uncertainties and ambiguities. There is perhaps a danger in this approach, though, of offering an apparently definitive account of observations, reducing scope for subsequent interpretation (J Lorimer, 2010). In research with humans, this is also problematic, though there is often scope for the participants to speak back, or for the reinterpretation of quotations by other readers. In the case of animals and technologies, the words left for interpretation are those of the researcher; the nonhuman actants are further distanced from the reader, even when being followed and discussed in detail.

Still photography

The second tool employed was still photography. For each focus of study, a series of photos was produced to capture actions and relationships observed. In two cases (following an individual cow and observing the open field), the photos were left to stand for themselves. In the second instance, focusing on the robot, the photos were accompanied by brief notes. First, a researcher followed cow 61's movement around the barn; the resultant images are presented chronologically in Figure 3.

Figure 3 here

While they do not focus on the second-by-second “empirical” descriptions (Lehner, 1996, p. 81) of actions outlined in the previous fieldnotes, such detail could have been offered with more rapid shooting. However, this set of photos offers more than a simple record of where the cow moved over a short period of time. Rather, the photos bring out some of the complexity that it is difficult to convey in writing alone. While the fieldnotes necessarily commented on particular interactions, specific actions of a single cow or the more general interactions within the barn as a whole, the photographs capture these together, not separating them out artificially.

Second, the photos highlight not only actions and interactions but also the materiality and physicality of cows in relation to their surroundings. This is especially true in Figures 3.5-3.7, when the cow turned away from the researcher, at a close distance, resulting in two close-up images of the cow’s body (Figures 3.5 and 3.6). In these, it is not just the cow’s body that is emphasised, but also the dirt she carried from the barn. While this might be taken for granted, bringing photos of cows from different barns and farming systems together might help to demonstrate the material effects of different barn maintenance regimes and cleaning technologies, showing how these relate to the lived experience of the cows.

Third, some photos show cows looking directly at the researcher and his camera. It would be difficult here to portray this as objective research; the researcher is directly implicated in the cow’s gaze, a theme we return briefly to in the next section on digital video. Here, the use of photography makes the researcher’s role and impact in relation to the animals more explicit than might be possible through fieldnotes alone.

The researcher who took still photographs at the robot found it hard to capture the difficulties of teat cup attachment that had been detailed in the fieldnotes, and so made notes to contextualise the photos. Some of these notes are included as labels in Figure 4; it was felt that what is happening in each photo may not otherwise be clear. Similarly, the researcher producing field notes at the robot noted that “I found it very difficult not to take photographs”; the complexity of the processes taking place can be hard to articulate and she felt that taking photographs would have provided useful illustration. In that sense, the two approaches go together very well and there was a feeling that we had set up an artificial separation. The researcher taking photos around the robot commented, for instance, on the “shuddering” of one of the cow’s legs during the attachment of the cups; again, photography alone could not capture such responses.

Figure 4 here

While these photos help to illustrate the milking process and complexity of technology to people who have not seen robotic milking previously, they give considerably less sense of the *form* of interaction taking place. The accompanying notes, therefore, observe

that photos couldn’t record the uncertainty of the machinery effectively – the teat cups were not fitted immediately and there were a couple of false starts. The cow was not passive either. There was no actual resistance, in the form of kicking or trying to escape, but the front right leg shuddered a few times as the cups were attached.

Further, the photos show a mechanical process taking place and are not dissimilar to the images that might appear in manufacturers’ marketing material; they give little sense of the contingency or “messiness” of the process – the uncertainty over whether attachment will occur and the frequent struggle to attach quickly and cleanly.

While Figure 4 shows the process of milking, a key characteristic of robotic milking is the apparent lack of event, when cows are not being milked and are either standing by the feed fence or resting in their cubicles, and when no humans are present. Given our interest in human-animal-technology interactions, there frequently appeared, therefore, to be little to capture through photography. This sense of lack-of-event was captured in the accompanying notes, still being written from behind the robot, which comment on the “silence, apart from the occasional clunking noise.” Presented with the back of a robot, the photos cease for a period of three minutes, after which another “cow came forward very slowly,” stopping a short distance away and looking directly at the robot for four minutes. The lack of photographs during this period, accompanied by the notes on the time involved, illustrates the quietness and stillness of the barn; implications can be drawn not only from the content of photographs but also from their absence. Although the machine was constantly making noise, cleaning itself, adjusting itself, the lack of event led the researcher to adopt a new position, “to view from the other side, and took a photo of ‘nothing happening’, as it were”

While Figure 5 appears to show, literally, nothing happening, this fails to capture the constant activity of the robot, which buzzes, splutters, steams, clangs and sprays even when no cows are being milked. This “lack” of event directs attention instead to micro- and mundane interactions and highlights the ironic (and ostensible) peripherality of the robots to much of the barn life that is supposedly structured around their presence.

Figure 5 here

Finally, in studying the open field, the camera partially overcame the obstacle of distance that had been commented on in the fieldnotes, with wide-angle shots (Figure 6) providing context and an

image of the whole field, and the zoom (Figure 7) allowing close-up shots of individuals and small groups of cows.

Figures 6 and 7 here

While useful as an illustration, the photos alone give little sense of how the cows moved around the field or how they communicated with each other. There is also a danger of reifying the relationship between distance and objectivity and of promoting detached observation. While in the barn the cows had shown an interest in the researcher and camera, here the researchers were sufficiently distant to allow an assumption that they were not directly impacting on the individuals observed. This should not, though, be allowed to distract from other forms of subjectivity inherent in the visual research process, notably around choice of framing, choice of images in publication and subsequent interpretation (e.g., Rose, 2012, p. 58).

Digital video

Our final approach employed digital video, beginning again by following an individual cow. In the recording, the multisensory nature of the barn environment became central, with the background noise of machinery and other cows, the sound of the cow's hoofs splashing in urine and excrement on the floor and even the breath of the cow being prominent. Video also helps to emphasise the exploratory, thinking, subjectivity of the cow. For instance, in Figure 8 (see also <http://www.youtube.com/watch?v=ChYkhJH5c0&feature=youtu.be>), the cow's "use" (see Holloway, Bear, & Wilkinson, 2013) of the robotic milking machine is not what might be promoted by manufacturers; here, the cow enters the robot but appears to be searching for discarded food

without the intention of being milked. Although the footage can only ever be a representation of the cow, and the cow cannot explain the action for herself, the inclusion of video does not foreclose further – and alternative – interpretation by readers. While it is not possible to carry out an elicitation interview, the video still appears to give the cow greater “voice” – or, at least, reduces the primacy of the researcher’s interpretation. Nonetheless, such claims should be treated with caution as the original framing and subsequent selection of footage remain in the hands of the researchers; the use of video should not be interpreted as a presentation of greater truth, or as a more objective representation (see Pink, 2013, pp. 52-53) than written notes.

Figure 8 here

Nonetheless, the use of video helps to overcome some of the problems found in making fieldnotes when little was “happening” – when the cow was sitting relatively still or performing a repetitive activity for a length of time. While fieldnotes might reduce such events to a couple of lines describing the cow as feeding, for instance, the video brings this to life.

In the video extract illustrated by Figure 9 (see also

<http://www.youtube.com/watch?v=KDW2IEUFNZc&feature=youtu.be>), the cow being followed stops walking and feeds through the fence for a number of minutes. Although the research project focused on relationships around robotic technology, this highlights the peripherality of such technology to much of the cow’s life, with far greater time being spent feeding, chewing the cud and sleeping. It also helps to illustrate the relations of individuals with the herd and how feeding itself is influenced by (lack of) human and technological presence, where the feed has not been pushed up to the fence recently and the cow must stretch to reach it.

Figure 9 here

In studying activity in and around the robot, video shows many of the events and activities outlined by the other approaches but gives a greater sense of the complexity of the process. Written description struggles to show the diversity of activities happening at any one time. Fieldnotes and still photography also struggle to convey the noise and movement, which are foregrounded in the video. Video also captures the multiple uses to which the robot is being put. Again, “use” is an ambiguous concept: in Figure 10 (see also

<http://www.youtube.com/watch?v=OSFpqxKP7hc&feature=youtu.be>), a second cow is seen licking the side of the milking machine, showing how the robot can play a role in cows’ lives beyond its central purpose.

Figure 10 here

As previously noted when taking still photographs of an individual cow, this approach also highlights the influence and impact of the researcher on the process, where the cow can be seen to be inquisitive about the researcher’s presence (see Figure 11 and <http://www.youtube.com/watch?v=0D0pTm6oj0s&feature=youtu.be>).

Figure 11 here

In a similar piece of fieldwork during another observational visit, the researcher experimented with the use of a tripod, so as to reduce the impact of researcher presence on the cows. However, as illustrated by Figure 12 (see also <http://www.youtube.com/watch?v=wouWiFYL9dA&feature=youtu.be>), the cows were often inquisitive about the presence of a new object in their surroundings; the researcher maintains an intrusive presence even through absence. Here, of course, it might be assumed that the camera's influence "on the conduct of those being recorded" (Heath, Hindmarsh, & Luff, 2010, p. 47) does not come through their *concern* about being recorded, but through new material presence.

Figure 12 here

In the final location, the open field, digital video was the only approach that gave a sense of the complexity of the situation in the sense of being able to capture stillness and movement concurrently, over a large space. In doing so, it highlighted the complex dynamics of a herd and the individual relationships within it. While the photos conveyed a sense of formation and use of space, the videos (see <http://www.youtube.com/watch?v=bFElhE2IUHA&feature=youtu.be>) help to convey a concurrent sense of stillness and activity (Figure 13) and of the active relationships between cows (Figure 14). Figure 14 also gives a sense of the hierarchical relationships that develop in herds, with one cow leading and others following.

Figures 13 and 14 here

Discussion and conclusions

In this conclusion, we do not merely want to extol the virtues of visual approaches to research but, rather, make explicit the qualities and challenges they raise. We begin by evaluating the three approaches in relation to our research. Subsequently, we address inadequacies, problems and concerns around the approaches before suggesting potential solutions and the scope for future methodological developments.

First, we turn to the role of fieldnotes. While cultural geographers, influenced by the turn to non-representational theory (Anderson & Harrison, 2011), have become increasingly critical of text-based representations of practice and affect, we would argue that they retained considerable value in our research. Writing fieldnotes documents empirical observations alongside recording initial interpretations and uncertainties, information on research practice and more-than-textual information such as sketches and diagrams. Fieldnotes can beneficially foreground the researcher (Crang & Cook, 2007, pp. 51-52) through reflexive commentary and provide a record of visual observations, but their treatment of nonhumans tends to give primacy to the researchers' interpretations. While we sympathise with Richardson-Ngwenya's (2014, p. 297) principle that "the cultivation of a vitalist geographical imagination," where nonhumans are understood to be "agentic and performative" (Gregson, Crang, Ahamed, Akhter, & Ferdous, 2010), is in many ways more important than the methods employed, we would argue that such an imagination might be sufficient during fieldwork, but less text-dependent records might be more beneficial in highlighting uncertainties around nonhuman action and intention.

Second, fieldnotes have limitations as a communicative tool; descriptions of interactions often vary between the dry and the anthropomorphic. Conversely, photographs offer illustrative potential in communicating research and offer greater potential in "evok[ing] the sensory experience and feel of...environments" (Rose, 2012, pp. 319-320) – in many ways less possible in writing (either because of the limitations of language or, more prosaically, because of journal word limits). Video potentially

takes these benefits further, “making the body audibly, visibly and viscerally present” (Bates, 2013, p. 29). This viscosity is overstated, as it promotes audiovisual engagement over smell, touch and affective presence, but the video did foreground the cows’ subjectivities, through showing them making choices, exploring and interacting.

Third, the different approaches we used to explain the photos reopens the debate in visual studies about the necessity of captioning and contextualising; Banks (2007) has argued for the contextualisation of images, using them in a similar way to interview quotes, while Schwartz (2007) has questioned “if a picture is worth a thousand words, why are you reading this paper?” The inclusion of nonhumans adds a further layer to this debate; the researchers here have limited privilege over the reader as they have not been able to ask questions of the research subjects. Additional commentary is intrinsically subjective and analytical. Conversely, including brief “factual” or descriptive labels, as in Figure 4, might provide sufficient context without rushing to explanation. Further, ethologists might argue that the photographs of cows require greater explanation because understanding of their actions (which even to the most skilled observed can only be partial) comes after hours, or even days, of observation. However, a key motive behind Schwartz’s argument is the retention of some ambiguity that leaves interpretive power with not only the author but also the reader. Including moving images offers similar advantages and adds a multisensory layer. While it would be possible to argue that video gives a more holistic record of interactions, this was not our specific intention. Rather, we follow Jamie Lorimer (2010, p. 244) in suggesting that their (whose?) “catalytic agency” is appreciated and channelled appropriately. In our case, the central attraction is leaving the subjectivity of the animals open to subsequent scrutiny. As noted, a problem in more-than-human research is of interpreting the nonhuman; we cannot access the thoughts or feelings of nonhumans through their words and reliance on fieldnotes can reduce scope for alternative interpretations of nonhuman practice. Including video research can offer the opportunity for nonhumans to “speak for themselves.”

Fourthly, although we deliberately separated the three visual approaches for discussion, there is scope to link them together in practice. While photos often appeared rather simplistic on their own, including written commentary alongside them can emphasise their content and alert readers to their wider, possibly non-visual, context. More significantly, spoken commentary could be given during video filming, offering reflections on the choice of shots and on anything out of frame. Again, this potential combination of methodological tools relates to the place of subjectivity and reflexivity in the research. In the sections on photography and video, the cows often paused to look at the researcher or investigated the camera, even when the researcher was not immediately present. While, positively, these approaches strongly emphasise our influence on the research, our presence also distorted our impression of the cows' lives; we were in part studying the effects of human absence while being present humans. Also, our "shooting script" approach sometimes led to focusing the camera on either moments of unusual behaviour or on capturing clichéd images of cows. Future work might usefully engage with more specialist technologies in producing visual representations of more-than-human social interaction. For instance, while Brown and Dilley (2012) used headcams with *dogwalkers*, it is possible to attach these to nonhuman participants. While we are conscious of Haraway's (2008) critique of such approaches in "edutainment," arguing that it is never possible to see through the eyes of an animal, such approaches would offer an alternative, more visceral, rendering of the cows' lives, where research would be led directly by their movements and interactions, rather than by the researchers' choice of frame or daily timetable.

A further alternative approach relates more closely to Johnston's (2008) notion of "responsible anthropomorphism," wherein research focuses on those who spend considerable time with animals. In her work, and in the closely-related research of Lorimer (2006), this being-with animals is visceral and embodied. We have not followed this approach directly as robotic milking is intended to reduce the time humans need to spend with cows. However, robotic milking leads to new ways of being with cows, which for some farmers includes the use of CCTV to monitor their herds from a distance. Further research might engage with such monitoring, following more traditional video elicitation

approaches and discuss the footage with the farmers who will be using it. Finally, while this paper argues for an increased engagement with visual methodologies in studying more-than-human relations, there is considerable scope to move beyond the immediately observable, engaging not only with more holistic forms of sensory ethnography but also with ongoing scientific research on the physiology of nonhuman animal personalities (e.g., Herborn, Coffey, Larcombe, Alexander, & Arnold, 2011).

In this paper, we have demonstrated the potential benefits of using visual approaches for the inclusion of nonhumans as more active, performative agents in research. Concurrently, we have destabilised some of the anthropocentric assumptions on which many visual methods are founded. Future research would usefully take these themes forward, exploring new technological possibilities and further developing the role of visual methods in understanding social relationships away from human bodily presence.

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Figures

Figure 1 – route of cow 200

Figure 2 – sketch of field on arrival, showing clusters of cows

Figure 3 – Photo sequence following cow 61 [Note – each individual photo within this figure should be labelled 3.1, 3.2, 3.3 etc up to 3.14]

Figure 4 – attachment of milking cups [Note – this is the overall caption for a series of photos, all of which have individual captions, as follows]

Figure 4.1 – Arm moving into place under cow

Figure 4.2 – Teats being scanned

Figure 4.3 – Teat cups being fitted

Figure 4.4 – Teat cups attached

Figure 4.5 – Milk flowing from cow into tank

Figure 4.6 – Screen on back of robot showing which cow is being milked (number 223 in this instance)

Figure 5 – ‘nothing happening’

Figure 6 – wide angle view of cows in open field

Figure 7 – cluster of cows (using zoom lens)

Figure 8 – cow appearing to search for food around robot

Figure 9 – cow stretching neck for food

Figure 10 – one cow licks the robot while another cow is milked

Figure 11 – cow stops feeding and watches researcher

Figure 12 – cow investigates video camera

Figure 13 – cows grazing and chewing

Figure 14 – one group of cows moves across the field